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# Validation of a steam based post-process pasteurization system for control of *Listeria monocytogenes* in ready-to-eat roast beef

## Abstract

*Listeria monocytogenes* has been implicated in outbreaks of illness involving ready-to-eat (RTE) meat products, prompting researchers to look into intervention technologies to reduce or eliminate this risk. In our study roast beef was inoculated with a 5-strain cocktail of *Listeria monocytogenes*, vacuum-packaged, and then pasteurized at 205°F for 0, 2, 3 or 4 min in a Stork RMS-Protecon Post-Process Pasteurization System. More bacteria were killed as pasteurization time increased. Initial inoculum level was 5.8 log<sub>10</sub> CFU/cm<sup>2</sup> of product surface area. Pasteurization for 2 min resulted in 2.5 to 2.7 log<sub>10</sub> CFU/cm<sup>2</sup> reductions. Similar reductions were seen at 3 min. At 4 min pasteurization, *L. monocytogenes* decreased in roast beef by approximately 4.5 log<sub>10</sub> CFU/cm<sup>2</sup>; over 99.99% had been killed. The Stork steam based system is effective for reducing the risks of *L. monocytogenes* in RTE roast beef while providing acceptable quality characteristics.

## Keywords

Cattlemen's Day, 2002; Kansas Agricultural Experiment Station contribution; no. 02-318-S; Report of progress (Kansas State University. Agricultural Experiment Station and Cooperative Extension Service); 890; Beef; Roast beef; Post-packaging; Ready-to-eat; Steam-Based pasteurization

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**VALIDATION OF A STEAM BASED POST-PROCESS  
PASTEURIZATION SYSTEM FOR CONTROL OF *LISTERIA*  
*MONOCYTOGENES* IN READY-TO-EAT ROAST BEEF**

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**Summary**

*Listeria monocytogenes* has been implicated in outbreaks of illness involving ready-to-eat (RTE) meat products, prompting researchers to look into intervention technologies to reduce or eliminate this risk. In our study roast beef was inoculated with a 5-strain cocktail of *Listeria monocytogenes*, vacuum-packaged, and then pasteurized at 205°F for 0, 2, 3 or 4 min in a Stork RMS-Protecon Post-Process Pasteurization System. More bacteria were killed as pasteurization time increased. Initial inoculum level was 5.8 log<sub>10</sub> CFU/cm<sup>2</sup> of product surface area. Pasteurization for 2 min resulted in 2.5 to 2.7 log<sub>10</sub> CFU/cm<sup>2</sup> reductions. Similar reductions were seen at 3 min. At 4 min pasteurization, *L. monocytogenes* decreased in roast beef by approximately 4.5 log<sub>10</sub> CFU/cm<sup>2</sup>; over 99.99% had been killed. The Stork steam based system is effective for reducing the risks of *L. monocytogenes* in RTE roast beef while providing acceptable quality characteristics.

(Key Words: Roast Beef, Post-Packaging, Ready-to-Eat, Steam-Based Pasteurization.)

**Introduction**

*Listeria monocytogenes* can contaminate cooked meat products between cooking and final packaging. Therefore, research is being focused on pasteurization of surfaces of cooked, ready-to-eat (RTE) meat products after packaging.

Both irradiation and thermal based pasteurization systems are being investigated. However, thermal based methods are easiest to implement because they do not require regulatory approval. Thermal systems, those based on saturated steam, appear to achieve the surface temperatures required to destroy *L. monocytogenes* in 1 to 4 min, without significantly affecting the sensory quality of the RTE meat products.

Our objective was to evaluate the effectiveness of the Stork RMS-Protecon Post-Process Pasteurization System in reducing or eliminating *L. monocytogenes* on RTE meat product surfaces after final packaging.

**Experimental Procedures**

Pre-cooked beef roasts (ca. 10 lb each) were stored at 40°F until pasteurization. Immediately before inoculation, beef roasts were cut into two equal halves. The resulting fresh-cut surfaces were labeled as "bottom" sides of the meat. The bottom sides were placed down to replicate retail conditions.

Five strains of *L. monocytogenes* were mixed with sterile 0.1% peptone water to achieve a final concentration of ca. 1 × 10<sup>9</sup> CFU/ml.

Beef roasts were placed on sterile stainless steel wire racks resting on a stainless steel trough. The inoculum was sprayed on both top and bottom surfaces by "misting" the mixed-strain inoculum in a "bio-containment" chamber. After inocu-

lation the products were placed in a laminar flow cabinet for one hour at room temperature to allow microbial attachment. Then all products were vacuum-packaged in CNP 320 cook-in bags (Cryovac, Duncan, SC) and pasteurized at the Kansas State University Aseptic Processing Laboratory.

All inoculated beef roasts except unpasteurized (0 min) were surface pasteurized in the Stork RMS-Protecon Post-Processing Pasteurization System at 205°F for 2, 3 or 4 min. Immediately after pasteurization, products were immersed in an ice-water bath for 10 min before sampling.

Samples were taken from the top and bottom surfaces. The flat bottom surfaces were cored twice (7.36 in<sup>2</sup>) and top surfaces were cored three times (11.04 in<sup>2</sup>). Cores from each sampling location per product were combined with 0.1% sterile PW, serially diluted, plated on Modified Oxoid Agar MOX (Difco Laboratories, Detroit, MI) and incubated at 100°F for 24 h. Colonies were counted and reported as log<sub>10</sub> CFU/cm<sup>2</sup>. There were four replications for each treatment.

## Results and Discussion

As pasteurization time increased, *Listeria* recovery decreased proportionally. Pasteurization for 2, 3, and 4 min resulted in reductions of 2.67, 3.57, and 4.48 log<sub>10</sub> CFU/cm<sup>2</sup> on the top portion from an initial level of 5.98 log<sub>10</sub> CFU/cm<sup>2</sup>, and reduction

of 2.51, 2.34, and 2.53 log<sub>10</sub> CFU/cm<sup>2</sup> on the bottom portion from an initial level of 5.82 log<sub>10</sub> CFU/cm<sup>2</sup>. On the top surface, 3.30 log<sub>10</sub> CFU/cm<sup>2</sup> survived 2 min of pasteurization, while 1.49 log<sub>10</sub> CFU/cm<sup>2</sup> survived pasteurization for 4 min (P≤0.05). More *L. monocytogenes* survived 3 or 4 min of pasteurization on the bottom than the top surface (P≤0.05). Reducing a microbial population of 5 log<sub>10</sub> CFU/cm<sup>2</sup> down to 2 log<sub>10</sub> represents a reduction of 99.9%. the microbial population added to our samples through inoculation are much higher than would be seen under naturally-occurring circumstances.

The USDA-FSIS mandates a zero tolerance policy for *L. monocytogenes* (FSIS, 1989) in RTE meat and poultry products. The mortality rate for *L. monocytogenes* infection is about 33% because of the virulence of this organism. Exposure to even a single cell may cause septicemia, meningitis, and abortion in susceptible humans. Earlier studies have reported about 53% of samples testing positive for *L. monocytogenes* in vacuum packaged RTE sliced meat.

This study validates the effectiveness of a saturated steam-based post-processing system for reducing or eliminating *L. monocytogenes* on surfaces of RTE deli meat products. The Stork RMS-Protecon system can be integrated into the RTE meat product manufacturing process as a Critical Control Point to reduce or eliminate the risk of *Listeria monocytogenes* in these products.